distance, the resulting positions and distances being all that is wanted. The volume is, however, a valuable addition to double star measurements.

The Ophiuridæ and Astrophytidæ of the "Challenger" Expedition. By Theodore Lyman. Part 2, Bull. Mus. Comp. Zool. Vol. vi., No. 2. (Cambridge, Mass.)

THIS is the second part of the preliminary description of the Ophiuridæ and Astrophytidæ dredged by the *Challenger*. Prof. Lyman issued the first part of the Prodromus some time ago. The Prodromus is of course merely an abridgment. Prof. Lyman's full account of the Ophiuridæ will appear in the large work on the *Challenger* Expedition. To the present part is added an index of species contained in the two parts, together with all others described elsewhere by Prof. Lyman. The whole forms a list of the greater portion of deep-sea Ophiurans and Astrophytons known. The list comprises fifty-three genera and about two hundred and twenty-three species. In the present part two new genera and sixty-three new species are described. Prof. Lyman considers that the Ophiuran which was recently described by Prof. Martin Duncan under the name of *Ophiolepis mirabilis* (*Linn. Soc. Journ. Zool.*, xiv. 460, 479), is a true Ophiopholis, lacking none of its characters, and standing quite near the typical *O. aculeata.* Priority is given in all cases by Prof. Lyman to specimens dredged by the *Challenger* over those obtained by the later series of dredgings carried out by the United States Government under Mr. Alexander Agassiz. A similar priority has been generously given by Mr. Agassiz to the *Challenger* Echinoidea, and Count de Pourtales has shown similar consideration in the matter of the corals. Owing to the delay in the publication of the *Challenger* results, the American naturalists could easily have secured priority for their collections, had they thought fit to do so. They have in their hands almost all the forms of any importance which the *Challenger* obtained, for by their continued operations they have dredged them nearly all on the United States coast and around the West Indies. The thanks of English naturalists is certainly due to the American zoologists for their courtesy in this matter.

LETTERS TO THE EDITOR

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts. No notice is taken of anonymous communications.*

[*The Editor urgently requests correspondents to keep their letters as short as possible. The pressure on his space is so great that it is impossible otherwise to ensure the appearance even of communications containing interesting and novel facts.*]

The Density of Chlorine

THE article on the density of chlorine, bromine, and iodine at high temperatures which appeared in NATURE, vol. xxi. p. 461, places before your readers in the clearest manner the present condition of this important question. The conclusion hinted at in the closing sentences of the article, viz. that these gases are under certain circumstances decomposed, is however scarcely warranted. Dr. Armstrong thinks that these substances may be more liable to decomposition when in a nascent state. It is generally supposed that in this condition the atoms of a substance are separate, having as yet had no opportunity of selecting a mate for their further career; if therefore we could observe the density of a gas in the nascent state, we should find that it was only half the theoretical density. In the case of chlorine evolved from platinum chloride at a high temperature we may readily imagine the emerging atom, set in rapid movement by the great heat, to be unable at any time to join with another to form a molecule; we should thus have the nascent state maintained, if I may be allowed the expression, as long as the temperature was high enough. It is further possible that there may be a wide interval between the temperature at which chlorine gas is molecular and that at which it is entirely atomic, and that in this interval a certain proportion of the gas varying with the temperature is resolved into its atoms, the rest remaining molecular. The gas would then have a density intermediate between the theoretical density 2·45 and its half, 1·23, a density in fact corresponding with that obtained in Meyer's experiments.

It may be urged that this attempt at an explanation, necessitating as it does a density varying with the temperature, is incompatible with the facts, since Meyer obtained a uniform density of about 1·6 in all his experiments. It must however be remembered that these observations cannot lay claim to great accuracy, and that the recurrence in several experiments of the same observed density may often be ascribed to chance.

Of this we have an excellent example in the experiments recently recorded in the *Proceedings* of the Royal Society by Prof. Dewar and Mr. Scott. The densities required were those of the vapours of potassium and sodium. In a first series of experiments which were made in an iron vessel the mean density of potassium vapour (referred to hydrogen) was found to be 40·8, that of sodium vapour 25·33, whence it was naturally inferred that those vapours were normal in character. In a second series of experiments, in which a platinum vessel was used, the densities 21 and 13 were found for potassium and sodium vapours respectively; from this it was with equal reason inferred that these metallic vapours were atomic, and resembled that of mercury. Unless platinum has a special dissociating effect on the molecules it must be admitted that in the one series or the other (since they were both made at similar temperatures) the concordance of the results was due to chance.

That the density of chlorine is really subject to gradual variation as the temperature increases, is rendered very probable by the results obtained by Meyer with iodine; the table of these results given in the article referred to (NATURE, vol. xxi. p. 461) shows clearly that the density of iodine decreases gradually, and there would seem to be no reason whatever for the assumption that it is complete at about 1,500° C.

I fear that I trespass much on your space in thus trying to point out that the otherwise inexplicable density 1·6 most probably represents only a stage on the road to the complete dissociation of the molecules, a stage more readily reached by a nascent gas than by one in which the molecules have to be dissociated; the importance of the subject must, however, be my excuse.

Clifton College, Bristol, March 21 FRED. D. BROWN

The Annual Variation of the Barometer in India

IT has been pointed out by Mr. Archibald, in NATURE (vol. xx. p. 54), that the late Mr. J. A. Broun, F.R.S., was probably mistaken in supposing (see vol. xix. p. 6) that there is no direct causal connection between the annual variations of temperature and atmospheric pressure in India. Mr. Broun appears to have adopted this opinion because, at all places in India where the annual oscillations of temperature and pressure are considerable, their turning points are not the same. The highest pressure usually occurs about the middle of December, and the lowest at the end of June, while the lowest temperature is reached during the first ten days of January, and the highest in the latter half of May.

Having been employed a short time ago in calculating the constants of Bessel's formulæ for the annual variations of temperature and pressure at Allahabad, I noticed that the first term of the pressure formula, which includes nine-tenths of the total variation, reaches its maximum almost exactly at the time of lowest annual temperature. The value of this term at the middle of January is ·271" sin 101°. 32', and its maximum therefore falls about 11½ days before the middle of January, that is on January 4th or 5th. The same term of Bessel's formula for Benares is represented by ·279" sin 102° 34', and for Roorkee by ·258" sin 103° 12'. The maximum pressure at these two stations therefore falls about the 3rd of January; if we take the oscillation of annual period alone. The first periodic term of the formula for the annual variation of pressure at Bombay is given by Mr. C. Chambers ("Meteorology of the Bombay Presidency," p. 16) as ·1405" sin 87° 2", the angle being counted from the 3rd of January at the rate of 30° for a month. This throws the maximum forward to the 5th January.

The pressure oscillation of full annual period may be supposed to represent the most important part of the effect of the annual variation of temperature, freed from all minor inequalities due to changes of wind and other causes. The close coincidence of the time at which this pressure oscillation attains its maximum with the time of the temperature minimum at the

earth's surface, and presumably at great elevations also, supports the generally-received conclusion that the pressure variation is an effect of the annual inequality of temperature.

Having thus good *primâ facie* evidence for believing that by far the greater part of the annual variation of pressure may be explained on simple hydrostatic principles, I thought it desirable to test this conclusion by Mr. Archibald's method of substraction, making use of somewhat fuller data than were at his disposal when he wrote the letter above referred to. The observations I have adopted are those of Roorkee, 887 feet above the sea-level; Dehra, 2,232 feet; Chakráta, 7,052 feet, and Leh, 11,503 feet elevation. The first three stations lie within a few miles of each other, their latitudes being 29° 52′, 30° 20′ and 30° 40′ N. respectively. Leh is at a considerable distance to the north, in latitude 34° 10′ N. The four stations are situated nearly on the same meridian, the difference of longitude between the most westerly and the most easterly amounting to less than half a degree.

The mean annual values of temperature and pressure at these four places are the following:—

Station.		Temperature.		Pressure.
Roorkee	(17 years)	74·9° F.	(12 years)	28·889 inches.
Dehra	(12 „)	70·6° F.	(12 „)	27·567 „
Chakráta	(10-11 „)	56·3° F.	(4 „)	23·225 „
Leh	(2-7 „)	39·3° F.	(4-6 „)	19·659 „

With the exception of the temperature figures for the winter months at Leh, the data are all for sufficiently long periods to be taken as fairly representing normal values of temperature and pressure. From these the average temperatures and barometric weights of three successive strata of air have been calculated, and the results, together with the variations in each month from the annual average values, are given in the next table.

Strata between	Roorkee and Dehra.		Dehra and Chakráta.		Chakráta and Leh.		Roorkee and Leh.	
Vertical thickness.	1,345 feet.		4,820 Feet.		4,451 Feet.		10,616 Feet.	
	Tem.	Bar. Weight	Tem.	Bar. Weight	Tem.	Bar. Weight	Tem.	Bar. Weight
Annual means.	72·8°	1·322″	63·4°	4·342″	47·8°	3·566″	57·1°	9·230″
Variations in January	−17·0	+·067	−15·2	+·129	−17·2	+·092	−20·0	+·289
February	−13·2	+·044	−12·6	+·123	−14·9	+·082	−15·5	+·249
March	− 4·6	+·013	− 5·3	+.050	− 7·5	+·034	− 6·7	+·097
April	+ 6·0	−·018	+ 3·3	−·022	+ 2·1	+·017	+ 3·7	−·022
May	+12·3	−·041	+10·0	−·073	+ 7·5	−·040	+10·2	−·152
June	+14·5	−·050	+13·0	−·138	+13·0	−·074	+15·0	−·262
July	+ 9·5	−·040	+ 8·9	−·108	+14·7	−·070	+15·7	−·217
August	+ 8·7	−·031	+ 8·1	−·097	+13·0	−·048	+13·7	−·176
September	+ 7·2	−·021	+ 6 7	−·075	+ 8·6	−·031	+ 9·2	−·126
October	+ 0·8	−·001	+ 0·6	+·003	0·0	+·004	+ 0·1	+·007
November	− 9·1	+·027	− 6·1	+·085	− 6·4	+·005	− 9·3	+·117
December	−16·0	+·049	−12·1	+·125	−12·4	+·027	−16·6	+·201

From these figures it is evident that when the temperature is above the average the pressure is below it, and *vice versâ*. The only exceptions to this rule, which applies to each separate stratum of air as well as to the whole thickness of 11,616 feet, occur in the months of April and October, when the variations of the barometric pressure from the mean of the year are within the limits of the probable error of the observations.

The variations of the density of each layer of the atmosphere are also very nearly *proportional* to the temperature variations, as they would be if the air expanded and contracted *freely* with changes of temperature. Thus the mean decrease of density for one degree of rise in temperature between Roorkee and Chakráta is ·00235. At the mean temperature of these two stations, 65·6°, the co-efficient of expansion per degree Fahr. is ·0019. The observed variation of density is thus slightly greater than that which would be caused by change of temperature alone, but the difference may be completely accounted for by the larger proportion of aqueous vapour in the air in the hot than in the cold months.

Taking the mean pressure of the lowest stratum of air (that between Roorkee and Dehra) to be the arithmetical mean of the pressures ob erved at the top and bottom, and supposing the mean tension of vapour in it to be similarly obtained, we may calculate the ratio of its densities in the hottest and coldest months by the usual formula:—

$$\frac{d}{d'} = \frac{P - \frac{3}{8}f}{P' - \frac{3}{8}f'} \quad \frac{460 + t'}{460 + t}$$

With the data P = 28·428, P′ = 27·982, f = ·301, f_2 = ·695, and the temperatures given in the preceding table, the ratio of the density in June to that in January comes out ·921, while the ratio of the barometric weights is ·916. A similar calculation for the stratum between Dehra and Chakráta gives the ratio of the densities in the hottest and coldest months equal to ·933, that of the barometric weights being ·943.

It follows from these results that the annual variation of the barometer over the plains of India and up to a considerable elevation in the Himalayas may be explained by simple hydrostatic principles. A moment's consideration will also show that the double oscillation observed at the hill stations, which is somewhat puzzling at first sight, may be explained in the same way, without bringing in any hypothetical saturated antimonsoon current.

It is the combination of this, at first sight, anomalous variation in the upper regions of the atmosphere, with the variations due to simple changes of density below, that gives rise to those peculiarities of the annual change of pressure in India which led Mr. Brown to give the weight of his great name in meteorology to an opinion that is clearly erroneous.

Allahabad, 18th February S. A. Hill

Gunnery Experiments

I HAVE read with interest the leading article on Gunnery Experiments in NATURE, vol. xxi. p. 437. The question seems to me to be one not alone of build, but—and perhaps principally—of muzzle-loading *versus* breech-loading, and of rifling for or without studs. The Admiralty seem to think so, as appears, I presume, from their resolution to adopt breech-loading for the turrets of the *Colossus*. With breech-loading double loading is an impossibility, as well as jamming of studs, since there are none, at least in the first artilleries of Europe. I dare say Sir W. Palisser's *build* is better than any other known in England; but then with it the best guns would be breech-loaders.

Contrary to the grand practice of Europe, England has hitherto, with characteristic tenacity, retained muzzle-loading for *great* guns. Now she will, I apprehend, have to reform and to pay enormous sums as a penalty, besides enduring the very inconvenient feeling of temporary inferiority in a means of great importance. X.

The Hague, March 15

A Museum Conference

I DEPRECATE as strongly, though not so violently, as "Academicus," an association to talk about museums, but I cannot agree with his reasoning on the subject of museums and their curators. I have had twenty years' daily experience of museum work, and at the risk of being dubbed a pretentious curator I can assert I have brought an average intelligence to bear on my work. With a certain amount of sympathy for the strictures of "Academicus" on the multiplication of conferences, I am yet free to assert that in no department of public work might and could greater public advantage result from close association of officials than from a union of museum curators. A provincial curator must often be oppressed with the conviction that he is spending weeks over a task which is already, in some other locality, done to his hands, and he must likewise know that the labour he is in other instances performing, and the objects he is manipulating would be sufficient for the wants of a dozen institutions like his own. He knows that he wants what others have, and that from his abundance others might be filled. Then again, in a general museum, the presiding officer, to be thoroughly efficient, should be master of the circle of the sciences, and have a familiar acquaintance with all arts and art. But science is all-embracing, art is long, and the arts of to-day are obsolete to-morrow. I say in contradiction of "Academicus" that museum officials only know their business when they know their ignorance, and that proper salaries are not their only or chief want. In a scientific sense the best men would be the worst museum curators, and were the municipalities of Great Britain each to offer the salary of a cabinet minister for the services of a museum superintendent, I do not think the institutions would thereby at once be so much revolutionised as "Academicus" thinks.

I am happy to be able to announce that the Council of the